



Limited Visual Dam Safety Inspection Summary Report

HI - 00049

Keaiwa Reservoir

Hawaii, Hawaii

Prepared by:

**U.S. ARMY CORPS OF ENGINEERS
HONOLULU ENGINEER DISTRICT**

**STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES**

May 2006

Dam ID: HI00049

Name: Keaiwa Reservoir

Limited Visual Dam Safety Inspection Conducted on: 6 April 2006.

I. Purpose:

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections were authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statutes, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections were conducted under joint agreements of the U.S. Army Corps of Engineers (ACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection was performed on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works included the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may or may not have appeared to be any immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

Dam ID: HI00049
Name: Keaiwa Reservoir

V. Inspection Team

Organization

State of Hawaii, Dept. of Land and Natural Resources
National Resource Conservation Service
U.S. Army Corps of Engineers

Name

Morris Ota
April Harden
Ray Kong

VI. Owner's Representatives Present

Mr. John Cross, representative for Olson Trust

VII. Summary Report Team

Organization

U.S. Army Corps of Engineers

State of Hawaii, Dept. of Land and Natural Resources

Name

Derek Chow
Joseph Koester
Denise Manuel
Edwin Matsuda

VIII. Dam Type

The dam is an earthen embankment.

IX. Dam Classification

The current hazard classification of this dam is: Unclassified

Based on available data, this classification is believed to still be applicable.

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Small

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

X. Summary of Inspection:

Condition Rating Criteria: The conditional terms in this report are used to generally describe the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

A. General appearance:

All reservoir and dam features were not easily recognizable. The dam appears to have a sizeable drainage area in addition to the inflow works.

Modifications / Improvements: There were no signs of any recent modifications.

Based on staff personnel, this reservoir has an incident history of:
Cracking in the reservoir walls and spillway due to earthquake.

Findings and Corrective Actions:

- a. The Owner shall maintain documentations including improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- b. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- c. Submit narrative and additional information detailing any known improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- d. Routine inspection logs were not inspected.
- e. Dam owners shall provide for routine inspection of the dam.
- f. The dam did not appear to be maintained on a regular basis.
- g. Access to site appears to be satisfactory.
- h. Access to dam is questionable during severe weather. Operational plans and emergency plans need to reflect this deficiency or access provided.
- i. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- j. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.

Dam ID: HI00049

Name: Keaiwa Reservoir

- k. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- l. Emergency Alarms / Monitors. There were no alarms or monitors observed on this reservoir.
- m. Power / Communication. There were no communication systems observed on this reservoir. There were no utility or power poles visible nearby.

B. Access / Security:

Access to the dam was accomplished via a County roadway.
Access requires a 4 wheel drive vehicle during severe storm conditions.
Operational plans need to reflect this deficiency or access improved.

Security issues. Access to the dam is via a locked gate.

C. Inflow Works:

The inflow works (Noguchi tunnel leading to a pipe, then flume) was observed only for the short length leading into the reservoir (a short flume portion). According to staff personnel, there is one inlet feeding the reservoir. This is via a flume. The intake or inlets have the ability to be shut off or diverted away from the reservoir during periods of heavy rains. This is done manually.

There is another inlet coming from the mountain drainage area, see photo showing sloped upstream area. Size unknown.

Findings and Corrective Actions:

- a. The inflow works were not fully inspected.
- b. The inflow works were not tested.
- c. The inflow works appeared to be in fair to poor condition and requires corrective action.
- d. The amount of potential water coming from the mountain should be determined and added to the overall inflow to the reservoir.

D. Reservoir

The reservoir level during the inspection was very low, at 12 feet per staff gage. Normal level is kept at 10 feet. According to the staff personnel, the level is kept low because of the crack in the wall and the unknown effect it may have on the stability of the dam should the water level be brought up to the reservoir's full capacity. Typically the spillway is never flowing

Findings and Corrective Actions:

- a. The reservoir was not fully inspected.
- b. The reservoir appeared to be in fair to poor condition and requires corrective action if the owner is planning to allow the reservoir to fill to levels higher than present.
- c. The crack in the wall as well as the condition of the reservoir requires assessment prior to allowing reservoir to fill to its full capacity.

E. Upstream Slope (Fair)

The upstream slope was at about 1V: 2H (Vertical/Horizontal) on one side and vertical the rest of the way around. The slopes are concrete lined.

Vegetation was observed growing between some horizontal joints and through cracks in the sloped portion of the upstream slope.

Erosions were not observed, the slope was not entirely visible.

Cracks were not observed; the slope was not entirely visible.

Sinkholes were not observed, the slope was not entirely visible.

The upstream slope was not entirely visible due to water in the reservoir.

Findings and Corrective Actions:

- a. The upstream slope was not fully inspected.
- b. The upstream slope appeared to be in fair to poor condition and requires corrective action. Corrective action is especially necessary if the reservoir is allowed to fill to its full capacity.
- c. Slope protection needs maintenance or repair. Cracks were observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.

F. Crest: (Fair)

The dam crest was approximately 8 feet wide. There was a dirt access road on top of the crest. There was high vegetation on portions of the crest, making detailed investigations impossible. Minor erosion was observed, limited primarily to some small gullies from surface drainage. Cracks were not observed, however the crest was not entirely visible. Sinkholes were not observed, however the crest was not entirely visible. Vegetation was observed on the edges of the crest. These were primarily small woody vegetation and high grass.

Findings and Corrective Actions:

- a. The dam crest was not fully inspected.
- b. The dam crest appeared to be in fair condition and requires corrective action.
- c. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

G. Downstream Slope: (Fair)

The downstream slope was in fair condition and not visible due to heavy vegetation. The slope was very steep, around a 1 to 1 slope.

There was no access to the downstream slope.

There was no slope protection observed on the downstream slope.

Erosion was not observed on the downstream slope, however the slope was not entirely visible.

Sinkholes were not observed on the downstream slope, however the slope was not entirely visible.

Vegetation was observed on the downstream slope. The majority of the vegetation was woody bushes and some trees.

Seepage was not observed on the downstream toe, however the slope was not entirely visible.

Findings and Corrective Actions:

- a. The downstream slope was not fully inspected.
- b. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- c. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- d. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- e. The slope was very steep, around a 1 to 1 slope, further study us required to verify slope stability.

H. Abutments / Toe: (Fair)

The abutments and toe were not entirely visible or identifiable due to heavy vegetative growth. Cracks in either direction were not observed, however the crest was not entirely visible.

Findings and Corrective Actions:

- a. The abutments and toe were not inspected.
- b. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
- c. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- d. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

I. Outlet Works: (Fair)

Not inspected in detail and not tested. The heavy vegetation should be removed and maintained low to enable easy visual inspection. The outlet works appeared to be an 8" pipe. The outlet works was controlled via a gate valve on the downstream side of the dam.

Findings and Corrective Actions:

- a. The outlet works were not inspected / not tested.
- b. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

J. Spillway: (UnSatisfactory)

The two spillways consisted of concrete channels. The rough dimensions were 5 feet wide by 3 feet deep at the approach, which narrows to 2 feet width in 10 feet. The spillways are presently not being used. There was heavy vegetation all along the downstream slope. Further investigations should be conducted to repair the spillways and conclude the capacity of the spillway.

Findings and Corrective Actions:

- a. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function if the reservoir is allowed to fill to its full capacity.
- b. Downstream of the spillway was blocked. Clear vegetative growth.
- c. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.

K. Down Stream Channel: (Fair/Unknown)

The down stream channel was not investigated.

Findings and Corrective Actions:

- a. The downstream channel was not inspected.
- b. The downstream channel appeared to be in fair to poor condition and requires corrective action.
- c. Clear vegetative growth and inspect to determine condition.

XI. Additional Comments:

Original field inspection notes were scanned and are attached to this summary report. Included are several photos from the site visit to detail important features of the project, captioned to be self-explanatory.

There was an earthquake around 1975, and the intensity was 7.5.

Per E-mail dated 5/02/06 10:43 am from Ray Kong, USACE.

Vehicle access to site is by a 4-wheel drive.

Other studies conducted for this reservoir is unknown

Reservoir: A staff gage observed in reservoir, and it was located on right side of one of the spillway (two found).

Crest: Please edit to fair to poor requiring clearing of vegetation.

Abutments/Toe: Please edit to fair to poor requiring clearing of vegetation.

Outlet works:

Outlet works consisted of a 8-inch PVC pipe, valve controlled on downstream.

Downstream channel: Items along stream bank were not visible.

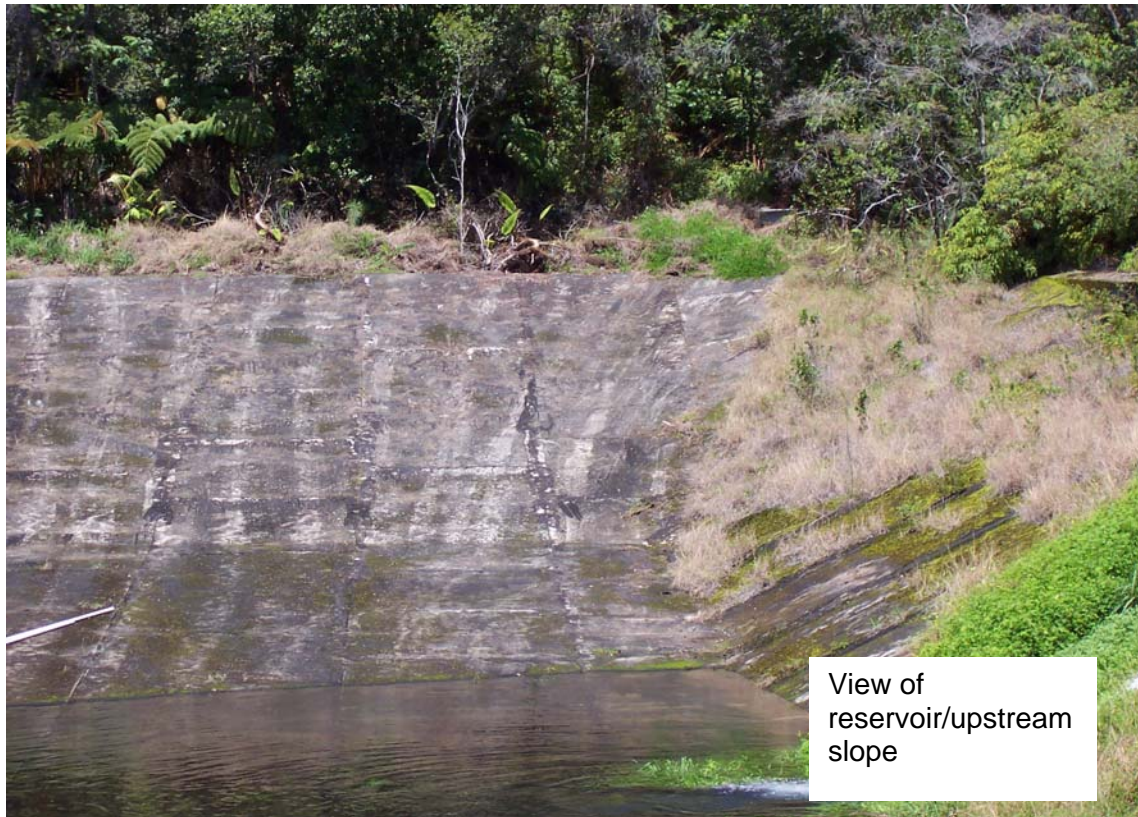
Comments: No immediate threat seen to the dam/reservoir at the time of inspection.

Recommended per DLNR policy to remove vegetation so a more thorough inspection could be performed.

PHOTOGRAPHS

Dam ID: HA-049

Name: Keaiwa Reservoir



View of
reservoir/upstream
slope

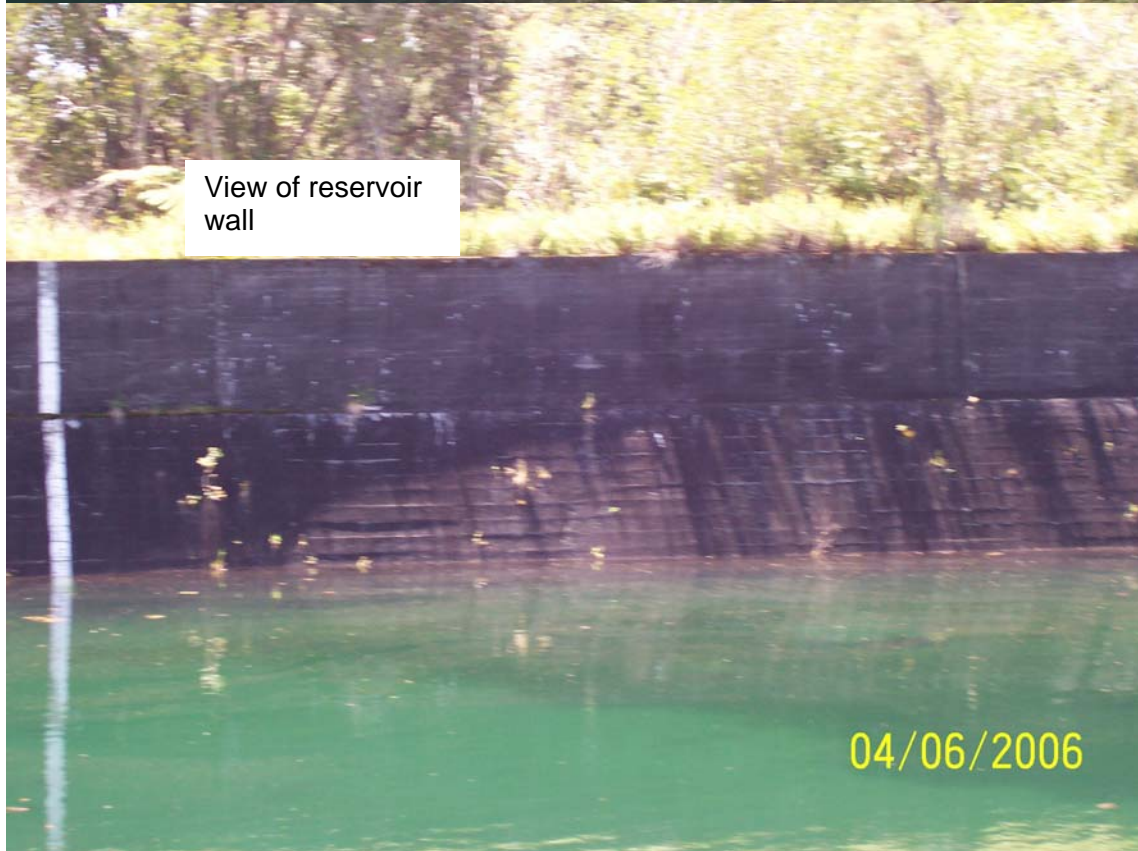


View of
reservoir/upstream
slope

04/06/2006

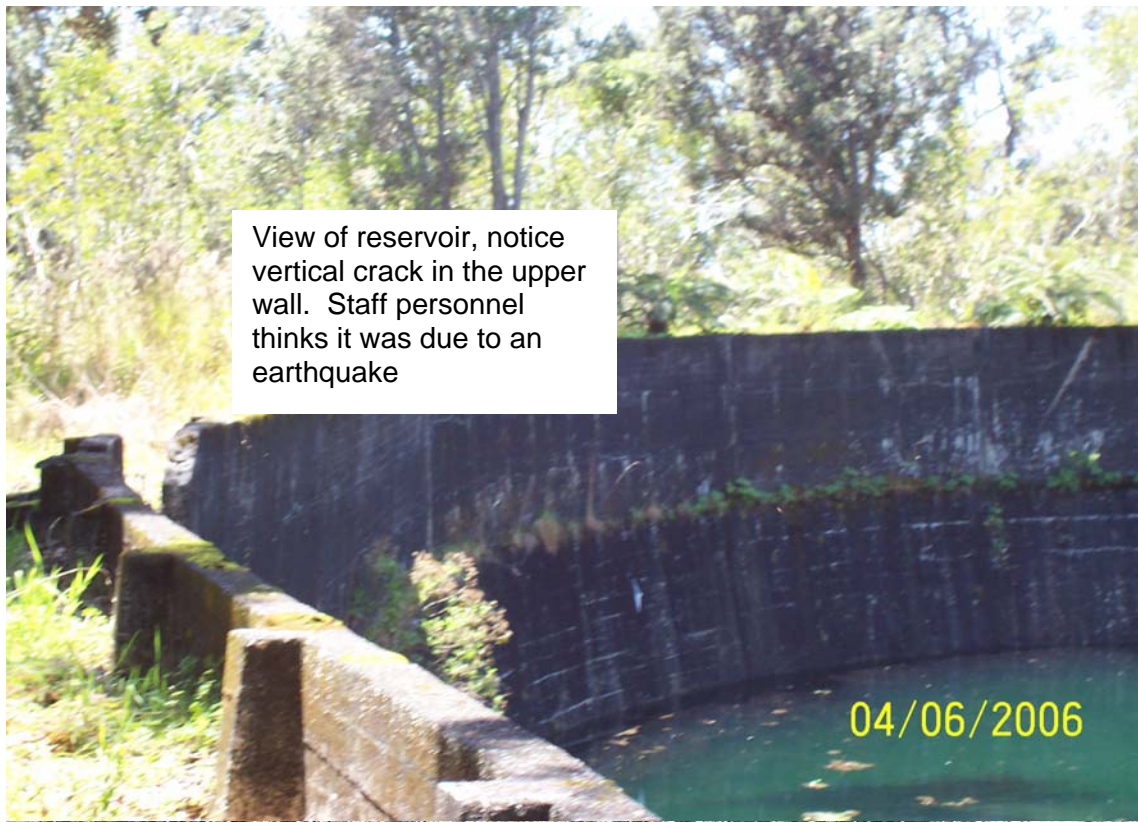
Dam ID: HA-049

Name: Keaiwa Reservoir



Dam ID: HA-049

Name: Keaiwa Reservoir



Dam ID: HA-049

Name: Keaiwa Reservoir

Close up of the
crack in the
reservoir wall

04/06/2006



Dam ID: HA-049

Name: Keaiwa Reservoir



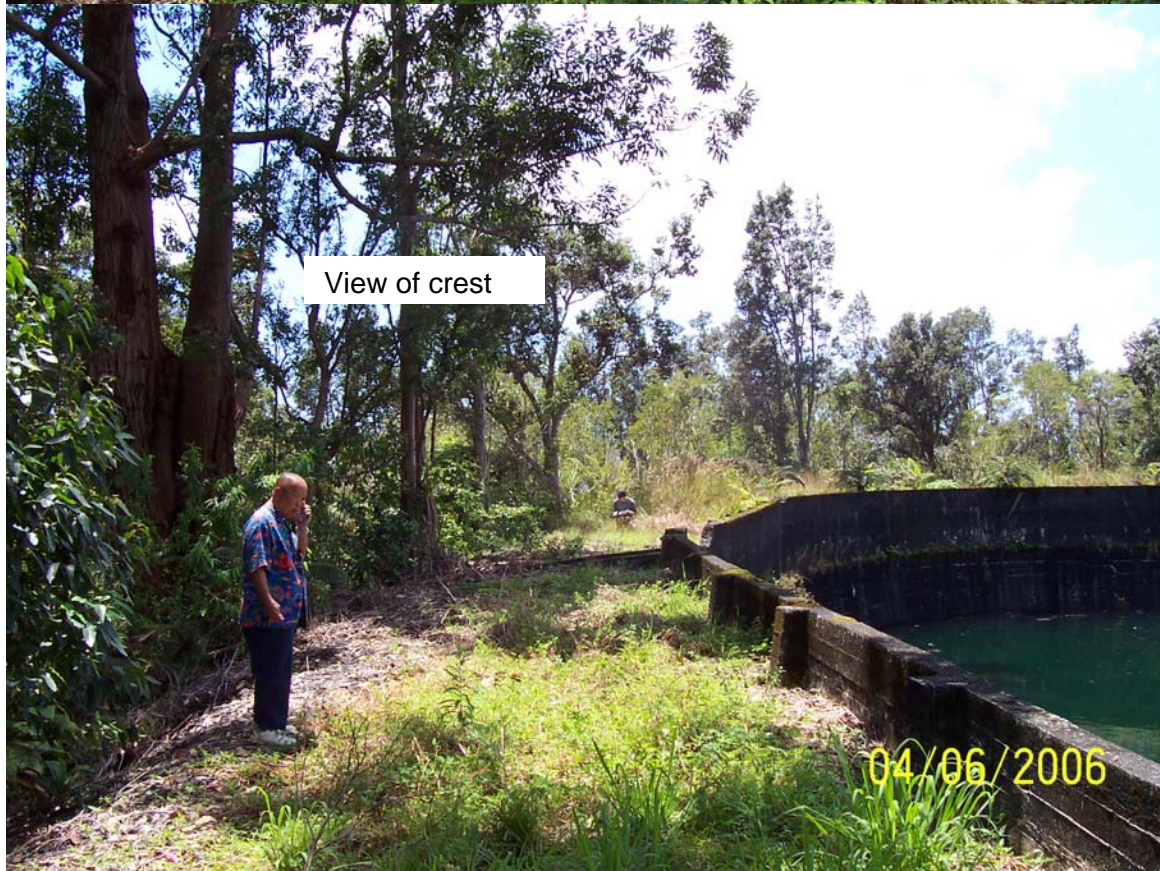
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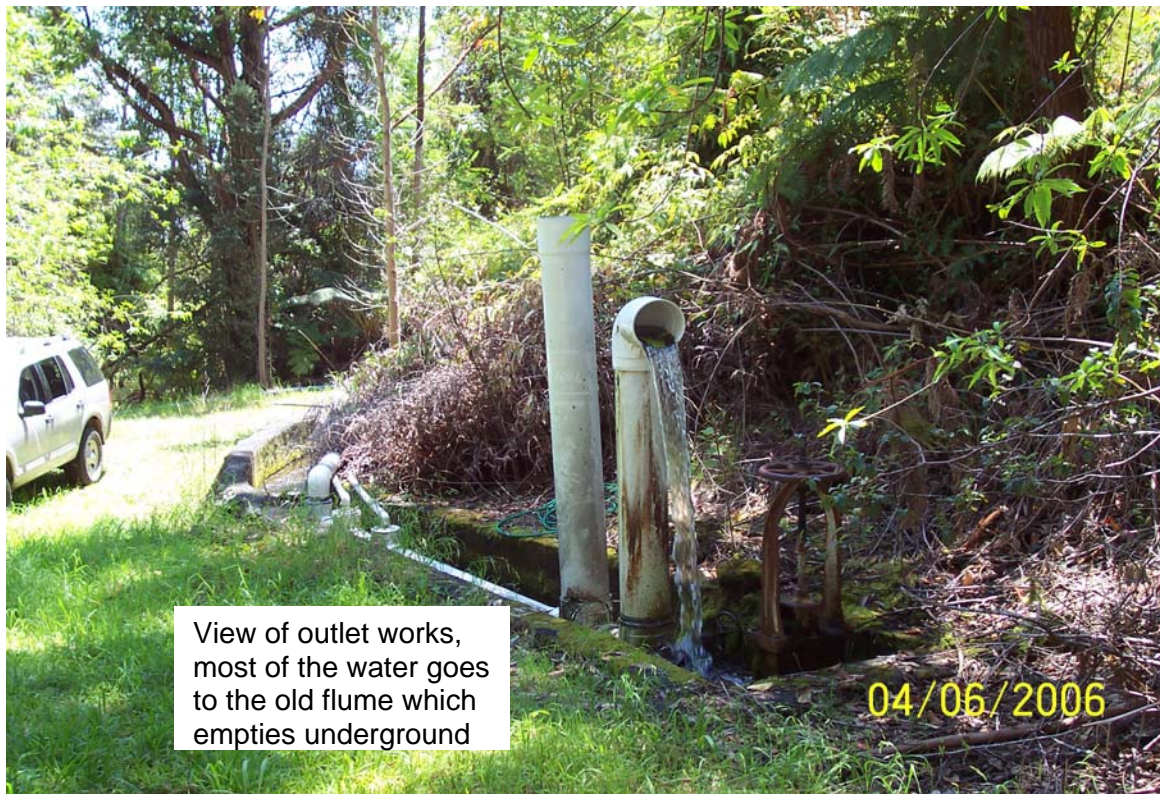
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Dam ID: HA-049

Name: Keaiwa Reservoir



FIELD INSPECTION SHEETS

Dam ID: HA-0049

KEAIWA RESERVOIR

Vulnerability Index:

Extreme	High	Moderate	Low
1	2	3	4

Inspection No: _____

Date: 6 APR. 2005

 STATE OF HAWAII - DLNR
 DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

Persons Present

Affiliation

Phone Number

RAY KONG

US Army Corps of Engineers

APRIL HANSEN

NRCS

MORRIS OTA

DLNR

Weather Condition:

☐ Rain previous day
 ☐ Rainy
 ☐ Drizzle / Mist
 ☐ Cloudy/Overcast
 ☐ Partly Cloudy
☒ Sunny
☐ Dry

Comments: _____

1. General: (Information currently on file, update as required)

Dam/Res. Name KEAIWA RESERVOIR

Owner Edmund C. Olson Trust No. II

(C054)

Owner Contact Mr. John Cross

Owner Ph. _____

Lessee _____

Lessee Ph. _____

O & M Contractor _____

O & M Ph. _____

Nearest Town MIDDLE & LOWER MOAULA CAMP

Latitude 19.2217° (decimal)

County HAWAII

Longitude 155.5417° (decimal)

Tax Map Key(s) (3) 9-6-7:001 & 002

Dam Status A: _____

Hazard Potential U: _____

Dam Size _____

Year Completed 1920

Dam Length 600 ft.

Dam Height 32 ft.

Normal Storage 22 ac.ft.

Max. Storage 40 ac.ft.

Max. Surface Area _____ ac.

Drainage Area _____ mi.

Spillway Type _____

Max. Spillway Q _____ cfs

13.5 MG

Owner owns land under dam facility: _____

Emergency Action Plan on file with the Department: NO

Reports on file with the Department: None on file.

Dam ID: HA-0049

KEAIWA RESERVOIR

Inspection No: _____

Date: 4/6/00

2. Questions for Owner's Rep.:

	Yes	No	Unknown	Comments
Construction Plans Available	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Site / Facility Map	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Operation & Maintenance Manual	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Emergency Action Plan	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Modifications / Improvements	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Conduct Routine Inspections	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Conduct Routine Maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Vehicle access to site	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Access during heavy rains	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Access when spillway is flowing	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Other Studies Conducted	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Phase I <input type="checkbox"/> Phase II <input type="checkbox"/> Hydraulics <input type="checkbox"/> Stability <input type="checkbox"/> Hazard <input type="checkbox"/> Seismic <input type="checkbox"/> Other: _____
Incident History	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Breached <input type="checkbox"/> Overtop <input type="checkbox"/> Slide <input type="checkbox"/> Down stream Flooding <input checked="" type="checkbox"/> Other: ~1975 EARTHQUAKE 7.5 INTENSITY
Reservoir's Current Use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Sediment <input checked="" type="checkbox"/> Irrigation <input type="checkbox"/> Recreation <input type="checkbox"/> Flood Control <input type="checkbox"/> Drinking Water <input type="checkbox"/> Power Generation <input checked="" type="checkbox"/> Other: FEEDS AG PARK RESERVOIR

Findings and Corrective Actions:

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☐ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- ☒ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☒ f. Routine inspection logs were not inspected.
- ☒ g. Dam owners shall provide for routine inspection of the dam.
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☐ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☐ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☐ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☐ o. _____

Additional Requirements:

The following investigative study(s) are:

Required Recommended

- | | | |
|-------------------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Phase I Study |
| <input type="checkbox"/> | <input type="checkbox"/> | Phase II Study (Including <input type="checkbox"/> Seepage <input type="checkbox"/> Hydrology/Hydraulics <input type="checkbox"/> EAP) |
| <input type="checkbox"/> | <input type="checkbox"/> | Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity) |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Stability Analysis |
| <input type="checkbox"/> | <input type="checkbox"/> | Seismic Analysis |
| <input type="checkbox"/> | <input type="checkbox"/> | Hazard Classification |
| <input type="checkbox"/> | <input type="checkbox"/> | Other: _____ |

Dam ID: HA-0049

KEAIWA RESERVOIR

Inspection No: _____

Date: 4/6/06

Physical Dam Features: (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

3. Reservoir:Level during inspection 12 ft per staff gage (gage / other) due to heavy rainsNormal Operating Level/Range 10 ft per staff gage (gage / other)Description: CONCRETE WALLS, LINED SLOPETypical Operation ☐ Spillway always flowing ☐ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms☒ Other: SIPHON DOWNSTREAM TO E. CREPS IT AT MAX. 12'Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☒ Not Visible ☐ None ObservedDescription: WATER IN RESERVOIR PREVENTS INSPECTION OF BOTTOM

Staff Gage:

Description: _____

Findings:

- ☐ a. The reservoir was not inspected.
- ☒ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time. AT PRESENT WATER DEPTH
- ☐ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

- ☐ e. The staff gage needs maintenance and/or repair. Description: _____
- ☐ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
- ☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
- ☒ h. NEED TO FIX FAULT IN UPPER PORTION OF WALL IF WILL USE TO MAX. CAPAC.

4. Intake Works Description:☒ Number of Intakes 1☒ Intake Culvert / PipeSize: 12 in. ☐ DIP ☐ Corrugated Metal ☒ PVC ☐ HDPE ☐ Concrete ☐ Other Hoguchi tunnel-sourceControl: ☐ Gate ☒ Valve ☐ Flow can either be Shut off or BypassedFrom: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☒ Other Hoguchi tunnel (horiz. shaft into mountain)☒ Ditch / FlumeDimension: 11" x 3" (Size x Depth) Shape rectangular aluminumSurface: ☐ Dirt ☐ Wood ☐ Concrete ☐ Lined w/ _____Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or BypassedFrom: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other Hoguchi pipelinenormal 650,000 gal/day
peak ~ 1MGD**Findings:**

- ☐ a. The intake works were not inspected.
- ☐ b. The intake works were not tested.
- ☒ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

- ☐ f. The intake works needs maintenance and/or repair. Description: _____
- ☐ g. _____

Dam ID: HA-0049

KEAIWA RESERVOIR

Inspection No: _____

Date: 4/6/06

5. Upstream Slope:

(Typical Slope ± vertical: _____)
☒ Other: concrete

Slope Protection: ☐ None ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner ☒ Other: concrete

☐ Defect in Protection: Description: _____

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed

Description: _____

Sinkholes: ☐ # Observed: _____ Size: _____ and _____ Depth ☐ Not Visible ☒ None Observed

Description: _____

Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Crack in wall from EARTHQUAKE

Findings:

- ☐ a. The upstream slope was not inspected.
- ☐ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☒ e. Slope protection needs maintenance or repair. Description: CRACK REPAIR IF MAX. CAPAC. TO BE USED
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ k. _____

Dam ID: HA-0049

KEAIWA RESERVOIR

Inspection No: _____

Date: 4/6/04

6. Crest:

Approximate Crest Width: 8'

Access:

☐ None ☒ Walking Path ☐ Roadway, Surface / Width / Usage: _____

Erosion:

☐ Loose soil w/ little vegetation ☐ Rut (<6") ☒ Gully (>6" deep) ☐ Not Visible ☐ None ObservedDescription: adj. to reservoir wall

Cracks:

☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed

Description: _____

Sinkholes:

☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☐ None Observed

Description: _____

Vegetation:

☐ None ☒ Low Ground Cover ☒ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

- ☒ a. The dam crest was not inspected. PARTIALLY DUE TO HEAVY VEGETATION
- ☒ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Access along the crest was satisfactory.
- ☐ f. Access along the crest was not possible. Description: _____
- ☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: _____
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☒ l. CLEAN VEGETATION AND RE-INSPECT.

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KEAIWA RESERVOIR

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7. Downstream Slope:

(Typical Slope \pm 1^v : 1^H)

Access: ☐ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☒ None Observed

Slope Protection: ☒ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☒ Not Visible ☐ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Seepage:

Seep Spot Number 1☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☒ Not Visible ☐ None Observed☐ Flowing, Description: _____Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Seep Spot Number 2☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed☐ Flowing, Description: _____Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

- ☐ a. The downstream slope was not inspected.
- ☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair.
Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☒ j. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☒ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.
- ☐ k. _____

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8. Abutments/Toe:

Erosion:

☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep)

☒ Not Visible

☒ None Observed

Description: _____

Cracks:

☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible

☒ Not Visible

☒ None Observed

Description: _____

Vegetation:

☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Seepage:

Seep Spot Number 1

☐ Green Vegetation

☐ Wet or Muddy Ground

☐ Ponding Water

☒ Not Visible

☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear

☐ Some particles

☐ Muddy

☐ Other: _____

Description: _____

Seep Spot Number 2

☐ Green Vegetation

☐ Wet or Muddy Ground

☐ Ponding Water

☐ Not Visible

☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear

☐ Some particles

☐ Muddy

☐ Other: _____

Description: _____

Findings:

- ☒ a. The abutments/toe were not inspected. **HEAVY VEGETATION**
- ☐ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair. Description: _____
- ☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☒ l. **Clear Vegetation and Re-inspect**

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9. Outlet Works:

Culvert / Pipe

Type / Size: _____

Culvert: ☐ Concrete ☐ Masonry ☐ unlined earth ☐ Other _____

Pipe: ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control Type: ☐ Gate ☐ Valve ☐ Other _____

Location: ☐ Control on Upstream side ☐ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

- ☒ a. The outlet works were not inspected.
- ☐ b. The outlet works were not tested.
- ☐ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The outlet works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.
- ☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. _____
- ☐ j. _____

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10. Spillway:

Type:

☐ None ☐ Culvert/Pipe ☒ Channel (2 EACH)

Description: 3' deep, 5' wide at reservoir, narrows to 2' in 10'

Dimension:

ft. Invert elevation: _____ ft. per staff gage

Slope Protection:

☐ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☒ Concrete / dirt-rock downstream

☐ Defect in Protection: Description: _____

Approach:

☐ Clear ☐ High Veg. ☐ Trees ☐ Other: _____

Erosion: Cracks

☐ Scour ☐ Gully ☐ Headcut ☐ Not Observed ☒ Other: FROM EARTHQUAKE AT PROTH SPILLWAYS

Description: _____

Vegetation:

☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

- ☐ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ b. The Spillway appeared to be in fair to poor condition and requires corrective action.
- ☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ d. Slope protection needs maintenance or repair. Description: _____
- ☐ e. The spillway approach was blocked. Clear approach.
- ☐ f. Severe scour erosion was observed which requires maintenance and/or repair.
Description: _____
- ☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.
- ☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
- ☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
- ☒ j. Fly Creek IF MAX. CAPAC. USED FOR RESERVOIR

11. Down Stream Channel:

Name: _____

Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☐ Defined Drainage-way ☐ Other _____

Items along Stream Bank: ☐ None ☐ Road ☐ Houses ☐ Town ☐ Not Inspected

Description: _____

Findings:

- ☒ a. The downstream channel was not inspected.
- ☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. _____

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Additional Comments:

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

Limitations and Intent of this Dam Safety Inspection:

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statutes Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

Revised: Dec. 1, 2003